Please write clearly in block capitals.

Centre number ☐☐☐☐☐          Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

# GCSE
# ENGINEERING

Unit 1  Written Paper

Wednesday 20 May 2020          Morning          Time allowed: 2 hours

**Materials**
For this paper you must have:
- normal writing and drawing instruments
- a calculator.

**Instructions**
- Use black ink or black ball-point pen.  Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.  Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book.  Write the question number against your answer(s).
- Some questions will require you to shade a circle.  If you make a mistake cross through the incorrect answer.
- Do all rough work in this book.  Cross through any work you do not want to be marked.

**Information**
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 120.
- You are reminded of the need for good English and clear presentation in your answers.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| **TOTAL** | |

Answer **all** questions in the spaces provided.

For each question completely fill in the circle alongside the appropriate answer.

CORRECT METHOD ● WRONG METHODS ⊗ ⊙ ⬳ ⃫

If you want to change your answer you must cross out your original answer as shown.

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown.

**0 1 . 1** Which **one** of the following properties describes the ability of a material to withstand wear and abrasion?

[1 mark]

**A** Ductility ⬭

**B** Hardness ⬭

**C** Stiffness ⬭

**D** Toughness ⬭

**0 1 . 2** The list below shows a range of different polymers. Shade **two** circles to identify the **thermosetting polymers**.

[2 marks]

**A** Acrylic ⬭

**B** Epoxy ⬭

**C** Melamine ⬭

**D** Nylon ⬭

**E** Polycarbonate ⬭

**F** Polystyrene ⬭

**0 1 . 3** Which **one** of the following materials is manufactured from layers of timber, bonded together with an adhesive?

**[1 mark]**

**A** Ceramic ⬭

**B** Medium Density Fibre board ⬭

**C** Nylon ⬭

**D** Plywood ⬭


**0 1 . 4** What is the name of the force that opposes the forward motion of an aircraft through the air?

**[1 mark]**

**A** Drag ⬭

**B** Lift ⬭

**C** Pitch ⬭

**D** Thrust ⬭


**Question 1 continues on the next page**

**Turn over ▶**

**0 1 . 5** **Figure 1** shows a component used in circuits.

**Figure 1**



What is the name of the component?

**[1 mark]**

**A** Capacitor ⬭

**B** Diode ⬭

**C** Resistor ⬭

**D** Transistor ⬭

**0 1 . 6** Shade **one** circle that gives the name of the process described below.

High pressure and temperature are used to make products from metal powder.

**[1 mark]**

**A** Die casting ⬭

**B** Etching ⬭

**C** Fused deposition ⬭

**D** Sintering ⬭

**0 1 . 7** **Figure 2** shows a mass-produced aluminium tray.

**Figure 2**



Complete the following statement using the word bank provided.

The tray in **Figure 2** has been made using a _____ process.

The moulds used in the process are usually made from _____

because the mould material needs to be very _____ .

**Word bank**

bending, brass, copper, ductile, folding, hard, high carbon steel, malleable, press forming

**[3 marks]**

**10**

**Turn over for the next question**

**Turn over ▶**

**0 2 . 1** **Figure 3** shows a right-angled bracket manufactured from 4 mm thick mild steel bar.

**Figure 3**

4 mm dia. hole
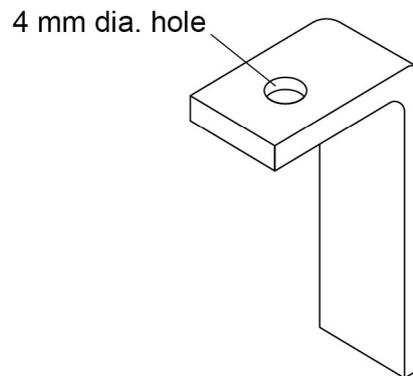
**One** bracket is to be made in a school workshop.

Complete the production plan below by giving the names of tools or equipment to be used for each stage.

**[5 marks]**

| Stage | Tool/equipment |
| --- | --- |
| Cut bar to length |  |
| Finish the cut edges of the bar |  |
| Mark the position of the hole |  |
| Make 4 mm diameter hole |  |
| Bend bar to a right angle |  |

**0 2 . 2** The steel bracket is to be used in a garden.

Name a suitable surface finish that could be applied to the bracket.

**[1 mark]**

**0 2 . 3** Give **three** reasons why a surface finish might be applied to the bracket.

**[3 marks]**

Reason 1 _____

_____

Reason 2 _____

_____

Reason 3 _____

_____

**0 2 . 4** A batch of components will be made using Computer Aided Manufacture (CAM).

Discuss **two** benefits of using CAM to produce a batch of components.

**[4 marks]**

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**Question 2 continues on the next page**

**Turn over ▶**

**0 2 . 5** **Figure 4** shows a support plate used to strengthen the bracket.

**Figure 4**

30 mm

**A**°

50 mm
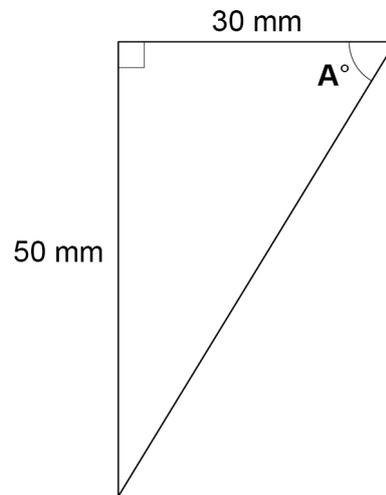
To make the bracket, angle **A**° needs to be calculated.

Calculate angle **A**° using the formula Tan A = Opposite/Adjacent.

Show your working.

**[3 marks]**

Answer _____

16

**Turn over for the next question**

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ANSWER IN THE SPACES PROVIDED**

**Turn over ▶**

| 0 | 3 | | **Figure 5** shows two pieces of a metal tray that are to be joined together. |

**Figure 5**
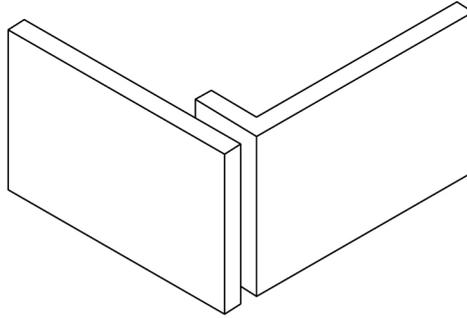
0 3 . 1    Give **two** advantages of using threaded fastenings, such as nuts and bolts, to join the pieces.

**[2 marks]**

Advantage 1 _____

_____

_____

Advantage 2 _____

_____

_____

0 3 . 2    Give **two** advantages of **hard soldering** the pieces together.

**[2 marks]**

Advantage 1 _____

_____

_____

Advantage 2 _____

_____

_____

**0 3 . 3** Name **two other** processes that use heat, and can be used to join the pieces together.

**[2 marks]**

Process 1 _____

_____

_____

Process 2 _____

_____

_____

**6**

**Turn over for the next question**

**Turn over ▶**

**0 4 . 1** A hand-held electric drill can be powered using a mains power supply or batteries.

Discuss why **both** methods are used.

[4 marks]

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**0 4 . 2** Use notes and/or sketches to explain the difference between an alternating current (AC) and a direct current (DC) power supply.

[3 marks]

**0 4 . 3** A circuit diagram for a lighting circuit is shown in **Figure 6**.

**Figure 6**
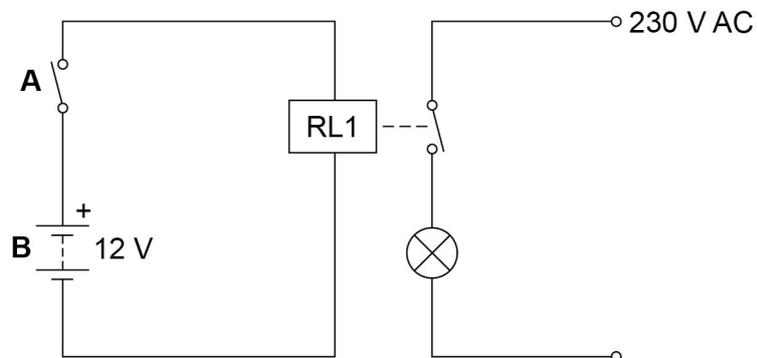


Name the components labelled **A** and **B** in **Figure 6**.

**[2 marks]**

Component **A** _____

Component **B** _____

**0 4 . 4** Explain the function of the relay RL1 in the lighting circuit shown in **Figure 6**.

**[2 marks]**

_____

_____

_____

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_____

**Question 4 continues on the next page**

**Turn over ▶**

**0 4 . 5**  A timer circuit is controlled by a microcontroller.

**Figure 7** shows the system diagram for the timer circuit.

**Figure 7**

Microcontroller
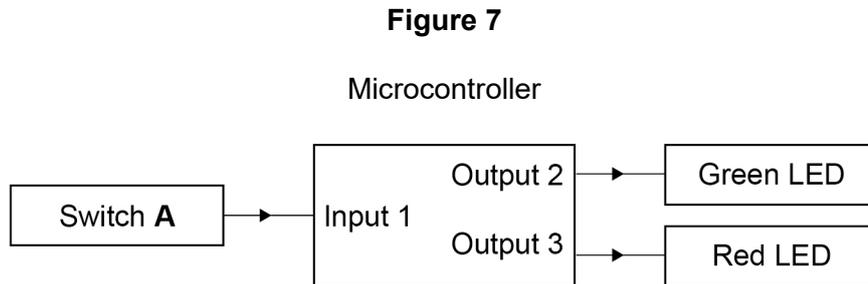


The system works as follows:

- the green LED is on
- when Switch **A** is pressed, the green LED turns off, and the red LED turns on for 10 seconds
- the red LED then turns off, and the green LED turns back on
- the sequence works continuously.

Complete the flowchart on **page 15** so that the system works as intended.

**[6 marks]**
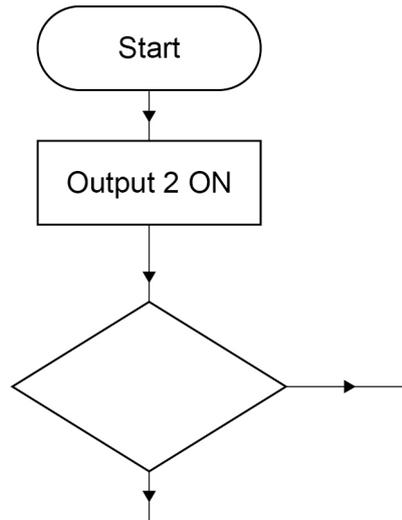
**Question 4 continues on the next page**

**Turn over ▶**

**0 4 . 6** Electronic circuits can be designed and tested using Computer Aided Design (CAD) before being manufactured.

Discuss **three** benefits of using CAD to **test** circuits before they are manufactured.

**[6 marks]**

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23

**Turn over for the next question**

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ANSWER  IN  THE  SPACES  PROVIDED**

**Turn over ▶**

| 0 | 5 | . | 1 | Describe **two** safety hazards and suitable precautions when using powered machinery such as lathes and milling machines.

[4 marks]

Hazard _____

Precaution _____

Hazard _____

Precaution _____

| 0 | 5 | . | 2 | **Figure 8** shows a steel component with a machined slot.

In the space on **page 19**, use notes and/or sketches to describe how the slot would be machined using a milling machine.

Include the names of tools and processes in your answer.

[8 marks]

**Figure 8**



Slot
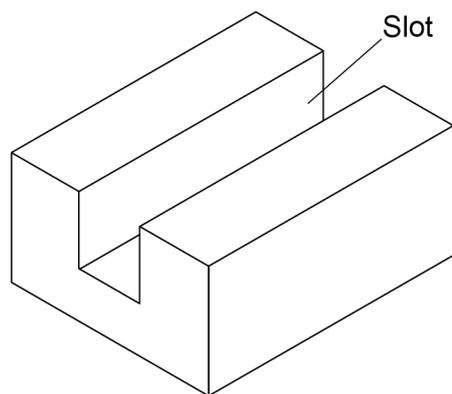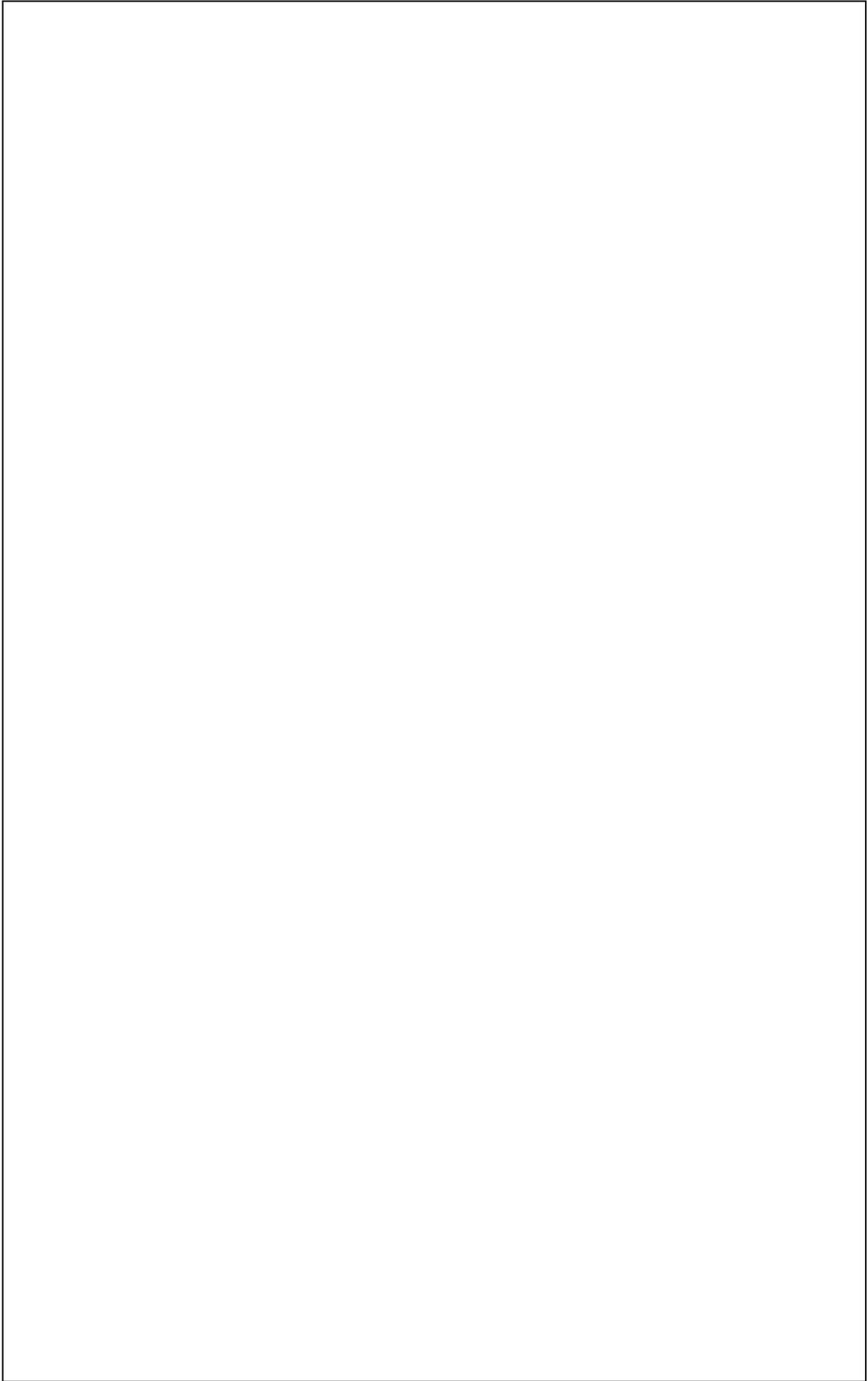
**12**

**Turn over ▶**

**0 6 . 1** A pulley system is designed to lift heavy loads.

The mechanical advantage of the pulley system is 3

Calculate the pulling effort needed to lift a load of 125 N.

**[3 marks]**

Formula _____

Working _____

_____

_____

Answer with units _____

**0 6 . 2** The cable used in a pulley system is 30 mm diameter.

Calculate the stress in the cable when a mass of 70 kg is lifted.

You should assume a value for gravity of 9.81

**[4 marks]**

Formula _____

Working _____

_____

_____

_____

Answer _____

**0 6 . 3** In **Figure 9** the link attached to pulley **A** is 200 mm long from top to bottom.

**Figure 9**
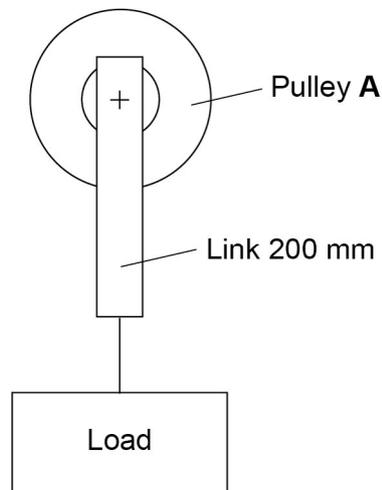


When a load is applied to the link, it stretches by 3 mm. Calculate the strain in the link.

**[3 marks]**

Formula _____

Working _____

_____

_____

_____

Answer _____

**0 6 . 4** When a stress of 1.8 $N/mm^2$ is applied to the link, the strain produced is 0.017

Calculate the Young's modulus of the link material.

Give your answer to **one** decimal place.

**[4 marks]**

Formula _____

Working _____

_____

_____

_____

Answer with units _____

14

**Turn over ▶**

**0 7 . 1** Study the mechanical system shown in **Figure 10**.

**Figure 10**
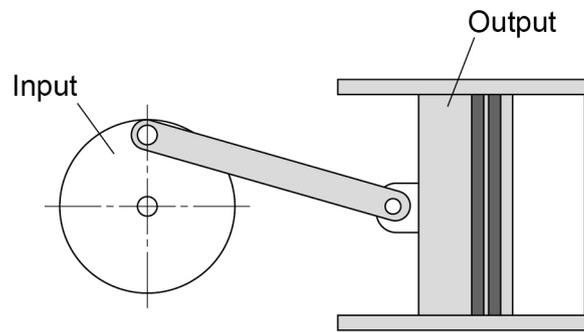


Complete the statement:

**[2 marks]**

The system converts _____ motion into _____ motion.

**0 7 . 2** **Figure 11** shows some internal parts of a car engine.

**Figure 11**



Discuss **two** reasons why car engines are lubricated.

**[4 marks]**

1 _____

_____

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_____

2 _____

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**0 7 . 3** Explain the function of cams in a car engine.

**[2 marks]**

_____

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**Turn over ▶**

**0 7 . 4** Cars can be powered by fossil fuels, such as petrol and diesel, or by batteries.

Analyse and evaluate the use of **both** technologies to power cars, taking into consideration the following aspects:

- environmental impact
- ease of use for the car driver.

**[9 marks]**

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**17**

**Turn over for the next question**

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ANSWER IN THE SPACES PROVIDED**

**Turn over ▶**

**0 8 . 1** Frames for racing bicycles are often made from carbon-fibre reinforced polymer (CRP).

Give **three** reasons why CRP is suitable for bicycle frames.

**[3 marks]**

Reason 1 _____

_____

Reason 2 _____

_____

Reason 3 _____

_____

**0 8 . 2** To assemble a bicycle wheel, a manufacturer uses:

- one wheel rim
- one hub
- 28 spokes.

The cost of the materials is shown in **Table 1**.

**Table 1**

| Item | Cost (each) |
|-----------|-------------|
| Wheel rim | £24.50 |
| Hub | £5.60 |
| Spoke | 58p |

The assembly process takes 40 minutes, and a worker is paid £12.60 per hour.

Calculate the cost of assembling **one** wheel.  Show your working.

**[4 marks]**

Working

Answer

**7**

**Turn over for the next question**

**0 9 . 1** 25 570 terawatts (TW) of electricity were generated in the UK in 2018.

1.3% of the electricity was generated from tidal sources.

Calculate the amount of electricity generated from tidal sources.

Give your answer, in terawatts, to **one** decimal place.

**[2 marks]**

Working _____

_____

_____

_____

_____

_____

Answer _____

| 0 | 9 | . | 2 | Energy sources for electricity generation are shown in **Table 2**.

**Table 2**

| Source | % of total |
|------------|------------|
| Coal | 38 |
| Gas | 23 |
| Renewables | 25 |
| Nuclear | 10 |
| Oil | 4 |

On the grid below, and using the data given in **Table 2**, present the information in graphical form.

Marks will be awarded for labelling the axes clearly, and accurately drawing the graph.

**[4 marks]**

**Turn over ▶**

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6

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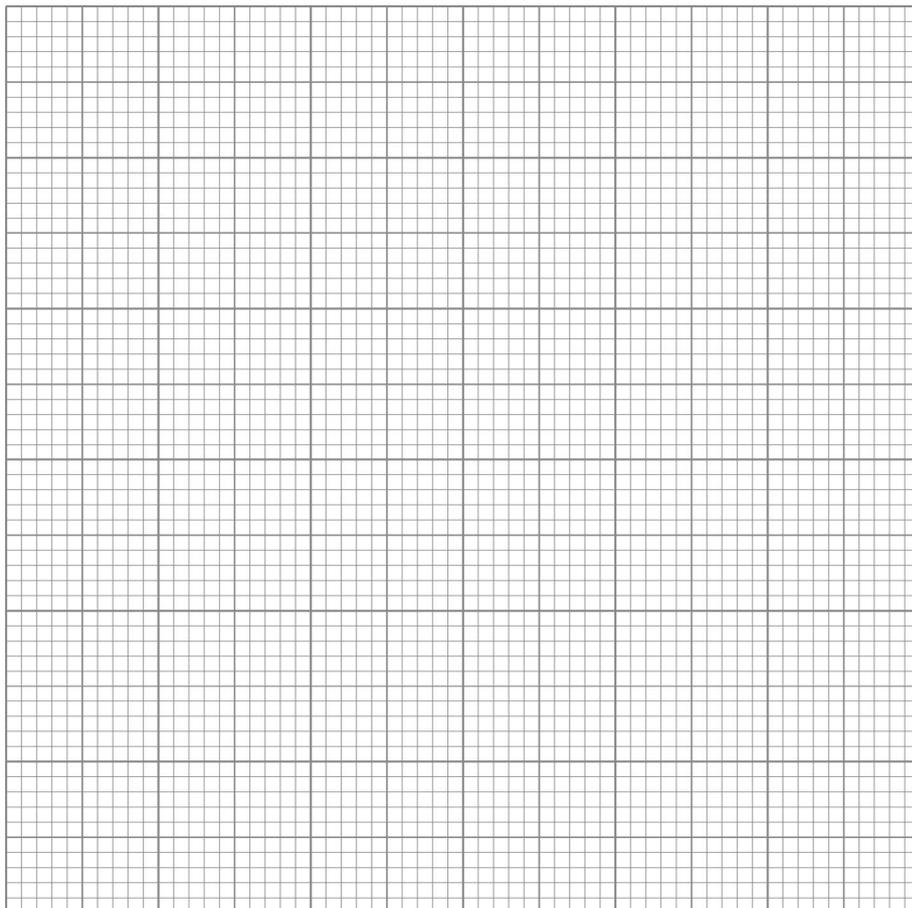
| 1 | 0 |.| 1 | Which is the correct formula for calculating series resistance?

**[1 mark]**

A $R_t = R_1 + R_2$ ⬭

B $R_t = R_1 - R_2$ ⬭

C $R_t = R_1 \times R_2$ ⬭

D $R_t = R_1 \div R_2$ ⬭

| 1 | 0 |.| 2 | **Figure 12** shows two resistors connected in series.

**Figure 12**



Calculate the value of resistor **A** if the total resistance of the resistors is 100 Ohms.

**[2 marks]**

Answer _____

3

IB/G/Jun20/8852/W

**1** **1**    Study the isometric drawing of the component shown in **Figure 13**.

**Figure 13**
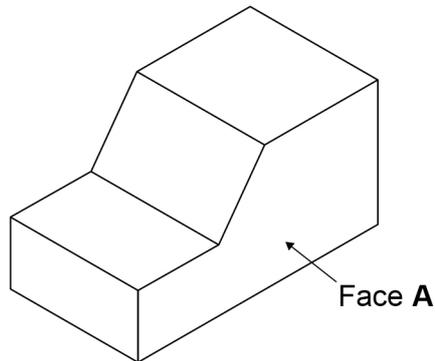
Face **A**

Complete the orthographic (3rd angle) drawing of the component below by:

- finishing the two incomplete views
- adding a dimension to show that Face **A** is 140 mm long
- naming the two views you have completed.

**[6 marks]**
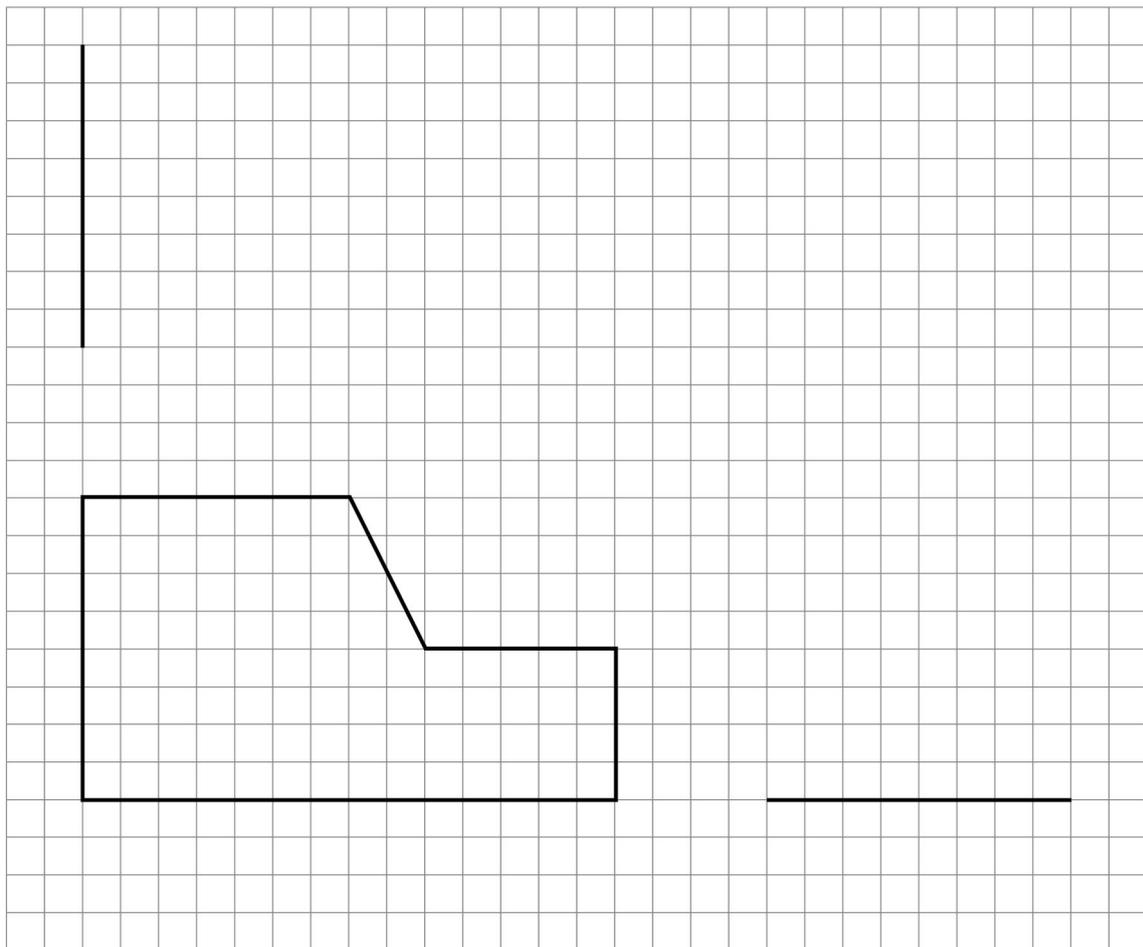
**END OF QUESTIONS**

6

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| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
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| Question number | Additional page, if required.<br>Write the question numbers in the left-hand margin. |
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